CLAIMS

I CLAIM:

1. A process instrument comprising:

a housing;

an active sensing element for sensing a characteristic of a process;

a control circuit disposed in the housing and electrically connected to the active sensing element for measuring the sensed characteristic; and

a safety barrier comprising a blocking capacitor barrier electrically connected between the control circuit and the active sensing element.

2. The process instrument of claim 1 wherein the active sensing element comprises a guided wave radar transmission line.

3. The process instrument of claim 1 wherein the active sensing element comprises a capacitance probe.

4. The process instrument of claim 1 wherein the blocking capacitor barrier comprises a plurality of series connected capacitors.

5. The process instrument of claim 1 wherein the blocking capacitor barrier comprises a plurality of series connected high voltage capacitors.

6. A process instrument comprising:

a housing;

a probe for sensing a characteristic of a process;

a control circuit disposed in the housing and electrically connected to the probe for measuring the sensed characteristic; and

a safety barrier comprising a plurality of series connected capacitors electrically connected between the control circuit and the probe.

7. The process instrument of claim 6 wherein the probe comprises a guided wave radar transmission line.

8. The process instrument of claim 6 wherein the probe comprises a capacitance probe.

9. A guided wave radar measurement instrument comprising:

a probe defining a guided wave radar transmission line;

a pulse circuit connected to the probe for generating a very fast stream of pulses on the transmission line and receiving reflected pulses returned on the transmission line, the reflected pulses representing a characteristic of a material being measured;

an equivalent time sampling circuit connected to the pulse circuit operable to sample reflected pulses to build a time multiplied picture of the reflected pulses, comprising a ramp generator circuit generating a sawtooth ramp signal used to selectively delay sampling reflected pulses to build the time multiplied picture, the sawtooth ramp signal having a controlled ramp start for each cycle and retrace at an end of the cycle; and

a processing circuit connected to the equivalent time sampling circuit for selectively controlling ramp start for each cycle and measuring round trip travel time for a pulse from the pulse circuit.

10. The guided wave radar measurement instrument of claim 9 wherein the ramp generator circuit comprises a latching ramp comparator, the latching ramp comparator latching at the end of the cycle and being reset by the processing circuit to start the ramp for each cycle.

11. The guided wave radar measurement instrument of claim 10 wherein the latching ramp comparator has an output coupled to a non-inverted input.

12. The guided wave radar measurement instrument of claim 11 wherein the processing circuit resets the latching comparator by applying a low voltage to the non-inverted input.

13. The guided wave radar measurement instrument of claim 10 wherein the ramp generator circuit comprises a resistor network operatively controlled by the processing circuit for controlling slope of the sawtooth ramp signal.

14. A time domain reflectometry measurement instrument comprising:

a probe;

a pulse circuit connected to the probe for generating a very fast stream of pulses on the probe and receiving reflected pulses returned on the probe, the reflected pulses representing a characteristic of a material being measured;

an equivalent time sampling circuit connected to the pulse circuit operable to sample reflected pulses to build a time multiplied picture of the reflected pulses, comprising a ramp generator circuit generating a sawtooth ramp signal used to selectively delay sampling reflected pulses to build the time multiplied picture, the ramp generator circuit comprising a ramp comparator that latches at a start voltage during each cycle until receiving a start ramp signal and retraces to the start voltage at an end of the cycle; and

a processing circuit connected to the equivalent time sampling circuit for selectively generating the start ramp signal for each cycle and measuring round trip travel time for a pulse from the pulse circuit.

15. The time domain reflectometry measurement instrument of claim 14 wherein the ramp comparator comprises a latching ramp comparator having an output coupled to a non-inverted input.

16. The time domain reflectometry measurement instrument of claim 15 wherein the processing circuit resets the latching comparator by applying a low voltage to the non-inverted input.

17. The time domain reflectometry measurement instrument of claim 14 wherein the ramp generator circuit comprises a resistor network operatively controlled by the processing circuit for controlling slope of the sawtooth ramp signal.

18. A guided wave radar transmitter comprising:

a probe defining a transmission line and including a reference marker proximate a top end of the probe;

a pulse circuit connected to the probe for generating pulses on the transmission line and receiving a reflected signal from the transmission line, the reflected signal selectively including a fiducial pulse representing the reference marker and a level pulse representing material along length of the probe; and

a controller operatively connected to the pulse circuit, the controller determining a level time between the fiducial pulse and the level pulse to determine material level, the controller comprising a latching comparator circuit for detecting the fiducial pulse and enabling level detection.

19. The guided wave radar transmitter of claim 18 further comprising a processing circuit connected to the controller for selectively resetting the latching comparator for each cycle and measuring round trip travel time for a pulse from the pulse circuit.

20. The guided wave radar transmitter of claim 18 wherein the latching comparator compares the reflected signal to a reference signal to detect the fiducial pulse.

21. The guided wave radar transmitter of claim 18 wherein the latching comparator comprises an operational amplifier having a diode connected between its output and an input to latch the comparator.

22. A guided wave radar transmitter comprising:

a probe defining a transmission line and including a reference marker proximate a top end of the probe;

a pulse circuit connected to the probe for generating pulses on the transmission line and receiving a reflected signal from the transmission line, the reflected signal selectively including a level pulse representing material along length of the probe; and

a controller operatively connected to the pulse circuit, the controller including a comparator for comparing the reflected signal to a threshold signal, the threshold signal being selected from a fixed threshold circuit or a proportional threshold circuit.

23. The guided wave radar transmitter of claim 22 wherein the proportional threshold circuit generates a threshold value as a fraction of a peak of the reflected signal.

24. The guided wave radar transmitter of claim 22 further comprising a processing circuit connected to the controller for selectively coupling the fixed threshold circuit or a proportional threshold circuit to the comparator.

25. A guided wave radar transmitter comprising:

a probe defining a transmission line and including a reference marker proximate a top end of the probe, the probe comprising one of a single rod probe, a coaxial probe or a twin rod probe;

a pulse circuit connected to the probe for generating pulses on the transmission line and receiving a reflected signal from the transmission line, the reflected signal selectively including a fiducial pulse representing the reference marker, the fiducial pulse being a negative pulse for a coaxial probe or a twin rod probe and being a positive pulse for a single rod probe; and

a controller operatively connected to the pulse circuit, the controller comprising a negative comparator for detecting a negative pulse and a positive comparator for detecting a positive pulse, each said comparator comparing the reflected signal to a select reference signal, and selector means for selectively operating one of the negative comparator and the positive comparator according to the type of probe being used for detecting the fiducial pulse.

26 The guided wave radar transmitter of claim 25 wherein the selector means comprises a processing circuit connected to the controller.

27 The guided wave radar transmitter of claim 26 wherein the processing circuit receives an output from the negative comparator and the positive comparator and detects the fiducial pulse from a falling edge of a first pulse from the negative comparator or from a leading edge of a first pulse from the positive comparator.

28. A guided wave radar transmitter comprising:

a probe defining a transmission line;

a pulse circuit connected to the probe for generating pulses on the transmission line and receiving a reflected signal from the transmission line, the reflected signal selectively including pulses representing impedance changes along length of the probe; and

a controller operatively connected to the pulse circuit, and including a comparator receiving the reflected signal for comparing the reflected signal to a reference signal to detect the pulses, and a gain selection circuit for generating plural levels of gain and selector means for selectively connecting the gain selection circuit to the comparator to generate the reference signal to selectively control a reference value.

29. The guided wave radar transmitter of claim 28 wherein the gain selection circuit comprises a plurality of resistors each connected by a switch between a voltage reference and the comparator and the switches are operated by the selector means.

30. The guided wave radar transmitter of claim 29 wherein the gain selection circuit comprises two switches providing four stages of gain.

31. The guided wave radar transmitter of claim 29 wherein the switches comprise analog switches and further comprising a processing circuit controlling the analog switches.

32. The guided wave radar transmitter of claim 28 wherein the selector means comprises a processing circuit connected to the controller.